RADIO FREQUENCY EXPOSURE REPORT

CENTRAL MAINE POWER SMART METER NETWORK

For the

Office of the Maine Public Advocate

Docket No. 2011-262

True North Associates

and

C² Systems

January 2013

Smart Meter RF Testing Report

True North Associates and C[2] Systems

January 2013

Re: ED FRIEDMAN, ET AL, Request for Commission Investigation Into Smart Meters & Smart Meter Opt-Out, Docket No. 2011-262

Overview

A new technology, the installation of smart meters and the creation of a 2.45 GHz wireless mesh network, serving residential and commercial buildings in the Central Maine Power (CMP) service territory, has caused public concern due to uncertainty over their operation and the possible effects that their operation may have on public health. In the context of Docket No. 2011-262, True North Associates was retained by the Office of the Maine Public Advocate (OPA) to measure the maximum and average power output of a sample of smart meters and other system components using the mesh network, and compare these readings to existing safety standards.

In consultation with the OPA, True North developed objectives for a limited program to measure radiofrequency output by and exposure from the digital meters installed as part of the Central Maine Power smart grid mesh network. The study was expanded to include the extender bridges (repeaters,) and collectors. True North contracted with C[2] Systems(C Squared,) a nationally-recognized radiofrequency emissions compliance testing organization, to perform the required field measurements, utilizing calibrated electromagnetic field measuring equipment certified by the FCC for measuring radiofrequency (RF) power density and exposure.

True North worked with OPA to ensure an independent and objective testing program. Based on earlier results provided to the Maine Public Utilities Commission in the report prepared by the Exponent Group[1], True North determined to focus its efforts on a selection of the most active meters and elements within the mesh network and to include all system components involved in broadcasting data within the network. To do this, limited consultation with representatives of CMP and the Trilliant Company was required to identify some of the specific locations meeting the objectives of this testing program.

In response to our requests for information, CMP, with the support of its network provider, Trilliant, identified groups of the most active utility meters, extender bridges, and data collectors in both Portland and Augusta. True North and C Squared tested one residential meter location that was identified on the list of meters supplied by CMP and two residential meter locations selected independent of CMP. The specific test locations or dates of testing were not disclosed to CMP.

---

[1] Exhibit B - Exponent, Inc. Report - Measurement Validation of Exposure Predictions from the Central Maine Power Smart Meter Network, September 19, 2012

The results obtained through the effort indicate that the measured exposure levels are well below the current FCC exposure limits. The testing methodology and detailed results are provided below.

Smart Meters and Mesh Network Operation

An advanced electric metering system is a "system of systems." This typically includes a range of interrelated components: in general, a digital meter measures and records a customer's electricity usage; a network interface delivers the meter data to the utility for processing and returns it to the customer in the form of an electronic or paper billing statement, as shown in Figure 1:

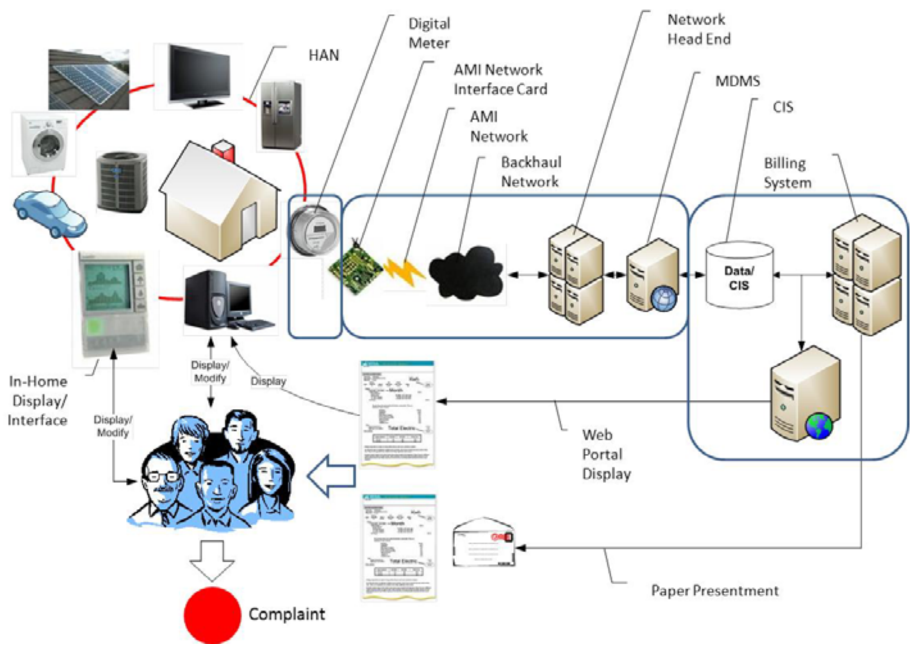

Figure 1 – Elements of a Typical Smart Meter Network

There are a number of product and service options that may be added to the network to facilitate various energy-conservation and load-management strategies. Many of these work through a home area network (HAN,) that may be stand-alone, or utilize 2-way Zigbee wireless communication capabilities that may be added to compliment the digital meter. The HAN features and services have not yet been enabled within the Central Maine Power mesh network. These elements, along with stand-alone Wi-Fi and cordless phone sets also generate RF signal output.

The key parts of CMP's Securemesh™ neighborhood-area smart grid mesh network considered in this study include the digital meter, the data extender bridges, or repeaters, which allow meters located outside the normal transmission range of the radio units that the meters use to communicate with the network, and the data collectors which receive data, either directly from nearby meters or from extender bridges. Collectors relay customer information into the system's backhaul network. The backhaul network ultimately feeds meter data into the utility's customer information and billing systems. While the repeaters and extender bridges also broadcast outbound signals to the meter network, a backhaul network typically utilizes fiber-optic cable to

allow faster rates of data transfer, which does not generate additional RF emissions. CMP's backhaul network was thus not considered in this investigation.

CMP's mesh network includes digital meters manufactured by General Electric and Landis & Gyr (LG). Both meters include a radio frequency transmitter/receiver unit that operates at a power output level of 1 W, in the range of 2402 MHz – 2472 MHz (2.4 to 2.47 GHz) in broadcast mode. The source of RF emissions originates in the electric meter's internal transceiver module whose output is .758 watts, which is connected to a printed circuit board antenna having a gain of 1 dBi. The total RF emissions, or effective isotropic radiated power (EIRP) out of the combined transceiver module and antenna, all housed within the meter, is 1.02 Watts, effectively 1 Watt. The strength of the RF signal emitted by each electric meter is fixed and does not change in response to the level of packet transmission activity. These meters are limited to a maximum duty cycle, or active broadcasting time, of no greater than 10%. These and other characteristics have previously been described in testimony filed as part of this investigation[2].

Extender bridges (repeaters) and data collectors broadcast at this same frequency range, at the same power output level (EIRP) as the residential meters. The radio units utilize channels 1-11 within this frequency range.

CMP's AMI network operates as a direct sequence spread spectrum (DSSS) data network, in which data signals are modulated, rather than pulsed. Data is transmitted and received within the network by the meters' transceiver units, which pass packets of information with customer energy usage to the utility (or send operating instructions from the utility) from meter to meter, up to a data collector. Within the DSSS mesh network, a meter may communicate directly with the network or it may transmit and receive information that passes through other meters. As noted in previous testimony, meters that are located closest to a network collector may retransmit the data for hundreds, up to several thousand dependent meters. This implies that these "parent" meters experience a greater level of activity due to rebroadcasting the data for other meters, than meters that are isolated or located farther away from a collector.

This greater activity increases an individual meter's duty cycle, the amount of time it is broadcasting, but not the antenna's signal strength, its effective isotropic radiated power (EIRP). Both of these factors, output duration and EIRP; affect human exposure to the broadcast electromagnetic field.

Duty Cycle and Exposure

Human exposure to an electromagnetic field occurs when an individual is subjected to electric, magnetic, or electromagnetic fields or to electric currents beyond those originating from physiological processes in the body and other natural sources. It is a function of the strength of the field or signal, and the amount of time that an individual is exposed to it.

The Federal Communications Commission (FCC), which regulates all equipment broadcasting radiofrequency signals, defines exposure in terms of the Maximum Permissible Exposure (MPE) to which an individual may be

[2] FRIEDMAN-01-09_Attachment_2_CONFIDENTIAL (2011-262)

exposed without harmful effect. The MPE limit varies with the frequency of the signal and the classification type of exposure (Controlled/Occupational vs. Uncontrolled/General Population). At the frequency used by the meters in CMP's smart grid network (2.45 GHz) the MPE limit for the general public is one milliwatt per square centimeter (1 mW per cm^2),averaged over a 30–minute time period. The occupational MPE, for reference, is averaged over a six-minute interval, making it five times higher than the limit for the general public.

Comparing the MPE values produced by the smart meters, repeaters, and data collectors selected for evaluation to the FCC standard was the core objective of this study. Key factors considered by True North and C Squared in assessing exposure for this study include:

- Digital meter duty cycle;
- Meter antenna broadcast power (EIRP);
- Broadcast channel (s) utilized by meter;
- Measurement meter characteristics matching meter broadcast characteristics and FCC standards;
- Strength of other sources of electromagnetic signals in the surrounding environment, such as proximity to other digital meters or sources of electromagnetic radiation exterior or interior to a structure, including: AM/FM radio broadcasts, wireless services, public safety, Wi-Fi, cordless phones, wireless routers, CCTV systems, cordless phones, car and home alarms, or Bluetooth;

As discussed below, several of these factors can complicate the accurate measurement of an individual meter's MPE.

The data from an individual digital meter operating in a mesh network is transmitted to the utility in short bursts which typically last only a few milliseconds. The total amount of time that a meter spends in transmitting data over a given standard time interval is referred to as the meter's duty cycle. A meter with a 100% duty cycle would be in broadcast mode continuously. A theoretical 1% duty cycle over the course of a day corresponds to 1% of 24 hours (1,440 minutes), or 14.4 min. per day.

The duty cycles of the meters evaluated in this study are typically small fractions of 1%. An individual meter sending only its own data to an extender bridge or collector has a total transmission time of 0.145 of a second per day, including hourly activity packets, or beacon signals, indicating meter status[3]. Roughly 99% of the meters in CMP's network have 60 or fewer dependent meters, and thus broadcast up to 8.6 seconds per day (0.145 seconds per day per meter times 60 meters). This is equivalent to a duty cycle of approximately .01% (8.6 seconds per day divided by 24 hours per day times 60 minutes per hour times 60 seconds per minute.)

One meter in the CMP mesh network was found to have nearly 5000 dependent meters[4]; its total broadcast time would be approximately 3 1/2 min. per day, equivalent to a duty cycle of 0.24% (0.145 seconds per day per meter times 5000 meters)/(24 hours per day times 60 minutes per hour times 60 seconds per minute.)

[3] Exhibit B - Exponent, Inc. Report - Measurement Validation of Exposure Predictions from the Central Maine Power Smart Meter Network, September 19, 2012, page 5-6.

[4] Exhibit B - Exponent, Inc. Report - Measurement Validation of Exposure Predictions from the Central Maine Power Smart Meter Network, September 19, 2012, page 12.

The majority of the CMP network activity occurs between midnight and 1:30 AM on a daily basis. Assessing exposure accurately requires that measurements be taken during the meter’s "active" period, and that the exposure meter be set to the correct channel that the meter is using to broadcast within the 2.45 GHz frequency range.

The short duration of the meters' active transmission cycle, and the low power output level of the broadcast antenna pose inherent problems for capturing representative data that accurately characterizes human exposure, general or occupational. It is also difficult to distinguish the exposure from a utility meter from that of other sources of RF emissions in the surrounding environment.

In addition, an accurate assessment of exposure may be difficult to obtain where the utility meter has the capability to utilize different channels while broadcasting to avoid data congestion within the network, and the exposure test equipment, or exposure meter, used to measure the strength of the broadcast signal is not set to the same channel. In the case of this study, it was not possible to know beforehand which channel an individual meter would be using during the brief time it was broadcasting.

Exposure Test Equipment

The measurement program implemented by True North Associates and C Squared included a variety of steps in its evaluation of RF fields. The purpose of this evaluation was to determine exposure resulting from the RF fields emitted by the smart meters and AMI system components, at different distances from the broadcast antenna.

The Addendum to this report provides the details of the equipment and measurement procedures.

All exposure measurements were taken using a calibrated meter and isotropic probe manufactured by Narda Safety Test Solutions (Narda STS). Narda is the worldwide leader in research and development of EMF measuring equipment and holds 95% of all patents for EMF measurements. Their RF measurement equipment is certified by the FCC for determining RF exposure in the field. Technical descriptions of this equipment and its use in this study are presented in Addendum 1, along with copies of its calibration certificates.

Test Site Selection

True North and C Squared gave significant attention to defining criteria for the test measurement sites at which they would measure exposure and to selecting specific locations that have high packet traffic.

As noted, the consultant team ultimately worked through the OPA to obtain information from CMP that identified suitable test locations for residential meters, extender bridges, and data collectors. Ultimately, three (3) residential locations, including one location selected specifically for interior measurements, two (2)

extender bridges/repeaters, and one (1) data collector were identified, and MPE measurements were taken over a series of days in January, 2013.

To focus the search on those utility meters and AMI system components with the highest levels of transmission activity, the consultant team provided a list of requirements that included both the desired numbers of potential measurement locations of each type, and the stipulation that all utility meters and AMI equipment have above the 99th percentile of packet traffic/dependent meters. CMP asked its contractor, Trilliant, to assist with the identification of potential measurement sites and returned lists of possible locations located in both Portland and Augusta.

The specification provided to CMP deliberately requested the identification of more locations than the consultant team intended to subsequently include as measurement sites in this study. This was done to avoid disclosure of the specific sites of the consultant team's activity to the utility. The OPA also invited the complainants in the investigation to identify one or more candidate locations for this study, however, this invitation was declined.

Because the operation of the mesh network is dynamic, it is not possible, except in cases where a utility meter has no dependents relaying data through it, to establish with certainty the number of dependent meters served, or the number of packets being transmitted through a particular utility meter on any given day. Following discussion with CMP and Trilliant the consultant team relied on network data describing the numbers of residential meters located within a radius of one-half-mile from the location of each Extender Bridge and collector as a proxy for specific information.

Ultimately, two of the residential meter locations included in the results provided in Addendum 1 were chosen directly by the consultant team, wholly without reference to information provided by CMP. One of the meters identified independently by the consultant team was located within one of the areas of greatest meter density in Portland identified by Trilliant and CMP. The other was deliberately located in an area of very low density to reduce the number of nearby RF sources and potentially better isolate the utility meter's signal.

Findings Summary

The RF exposure measurement survey detailed in the report found that the included Smart Meters and associated AMI infrastructure devices produced emissions significantly below the maximum power density exposure levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01 for the general public.

In the extreme case the survey identified, the highest peak (short duration) percent of Maximum Permissible Exposure (MPE) was 13.4% of the FCC limit, measured near the Smart Meter at location M-1 outside of the Smart Meter's expected period of maximum activity. This reading likely included the RF signals from a number of possible nearby sources. The equivalent time-averaged exposure level would have been 4.6% of the FCC exposure limit for the General Population. See Addendum 1 for additional detail on the relationship between peak and time-averaged exposures.

Selected Glossary

Antenna – a device designed to efficiently convert conducted electrical energy into radiating electromagnetic waves in free space, and vice versa

Averaging Time – the Time. Over Which Exposure Is Averaged to Determine Compliance with Maximum Permissible Exposure (MPE) Standards at a Given Frequency;

Beacon Signal – a very short duration signal sent by a smart meter to indicate their availability to connect to other meters within a mesh network these signals typically occur periodically (hourly) and this may vary depending on conditions within the mesh network and any instructions to transmit data to other meters within the network;

Continuous Exposure – exposure times during exposure to an electromagnetic field that exceeds the typical averaging time: 6 min. for occupational exposure and 30 min. for the general public. Exposure periods of less than the averaging time typically describe short-term exposure;

Decibel (dB) – a dimensionless factor used to compare a measured value of power or signal strength to a reference level, using logarithms to base 10. For example: from a reference level of 1 milliwatt (mW), a 10dB increase in intensity (+10 dB) would be 10 mW; a 20 dB increase would be 100 mW. A decrease of 10 dB (-10 dB) would be 0.1 mW. A value referenced to a signal emitted (or received) by a theoretical antenna that does not have a preferential direction is designated as dB_i, where the "i" designates isotropic or equal strength in all directions;

Effective Isotropic Radiated Power (EIRP) – the apparent transmitted power from a theoretical isotropic antenna transmitting uniformly in all possible directions;

Electric Field Strength – a factor describing the force that an electrical charge has on other charges around it measured in volts per meter (V/m);

Electromagnetic Field – a combination of an electric field and a magnetic field related in a fixed way that can convey electromagnetic energy. And antenna transmitting a signal produces an electromagnetic field;

Gain, Antenna – a description of the ability of an antenna to concentrate signal strength into a directional beam. A laser is an example of a process with high or large gain, since it concentrates energy into a narrow directional beam. Cellular antennas may exhibit gains of 10 dB or more, concentrating signal power by a factor of 10 times in the direction of the main beam, creating an effective radiated power greater than actual transmitter output power. The strength of the antenna's emitted signals will be greatly decreased in other directions, for example behind the antenna. Since it radiates equally in all directions, the gain of a theoretical isotropic antenna is 0 dB;

Maximum Permissible Exposure (MPE) – the average (root mean square) and peak electromagnetic field strength or equivalent power density and the induced and contact currents to which a person may be exposed without harmful effect, including an appropriate safety factor;

Mesh Network – a self-healing network, typically wireless, in which multiple nodes (meters) communicate among themselves and relay data to a central access point. Data pathways within the network are automatically configured and reconfigured to transmit data in the event that a single node fails;

Power Density – is the power per unit area normal to the direction of an electric or magnetic field. This is normally expressed as watts per square meter (W/m^2), or milliwatts or microwatts per square centimeter;

Radiation Pattern – describes the distribution of radiofrequency energy emitted from an antenna in space. Two patterns are used to describe an antenna's radiation pattern: one for the horizontal plane and another for the vertical plane;

Radio Frequency (RF) – typically considered as the frequency range in the electromagnetic spectrum extending from 3 kHz to 300 GHz;

Spatial Average – the average value of power density along a vertical line representing a person's height;

Spectrum Analyzer – an electronic instrument that detects and displays electromagnetic signals occurring within a selected part of the RF spectrum. They typically appear as peaks on a visual display. Spectrum analyzers continuously sweep a given frequency range at a high rate allowing for the detection and observation of intermittent signals, similar to those emitted by smart meters;

Specific Absorption Rate (SAR) – guideline values for human exposure to radiofrequency fields, describing threshold values above which adverse biological effects may occur;

Time-Averaged Exposure – an average of the exposure occurring over a specified time. All scientifically-based RF exposure limits are expressed in terms of time averaged values. For occupational exposures the averaging time is 6 min. and for the general public this is increased to 30 min, making the allowable exposure limit for the general public one-fifth that of the corresponding occupational limit.

ADDENDUM 1

RADIO FREQUENCY EXPOSURE MEASUREMENTS & FINDINGS

CENTRAL MAINE POWER SMART METER NETWORK

GREATER PORTLAND, ME

JANUARY 2013

C Squared Systems, LLC
65 Dartmouth Drive, Unit A3
Auburn, NH 03032
Phone: (603) 644-2800
support@csquaredsystems.com

C2 Systems

Table of Contents

C2 Systems

List of Tables

List of Figures

C2 Systems

List of Photos

1. Overview

The purpose of this report is to investigate the exposure levels of radiofrequency (RF) signals transmitting from Central Maine Power Company's Advanced Metering Infrastructure (AMI) Network, herein referred to as "Smart Meter" network. At the request of the Public Advocate Office and True North Associates, C Squared Systems, LLC (C Squared) performed field measurements of CMP's AMI network in and around the Greater Portland, ME area. These field measurements involved a sampling of AMI devices comprising CMP's smart Grid infrastructure including; meters and/or meter banks, repeaters/extender bridges and collectors.

In addition to field measurements of selected AMI meter locations, exposure measurement testing conducted by C Squared included two AMI repeaters and, one AMI collector/extender bridge.[1]

All radiofrequency field measurements were performed using FCC type-accepted and calibrated equipment and were completed during the period January 7 through January 22, 2013.

RF Engineer Conducting Survey	Dan Goulet, C Squared Systems, LLC
Survey Dates:	1/7/2013 through 1/22/2013
Surveys Times (Smart Meters)	Between the hours of 11:50 PM & 1:05AM
Survey Times: Repeater/Collectors	Between the hours of 11:00AM and 2:00PM

Table 1: Survey Summary Information

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)"and may be found in Attachment B of this Report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment provided they are fully aware of the potential for exposure, and are able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels considered acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

[1] The field measurement of AMI repeaters, collectors/extender bridges was not included in the 2012 testing conducted by Exponent Inc.

C2 Systems

3. Measurement Equipment & Procedure

Frequencies from 300 KHz to 50 GHz were measured using the Narda Probe EA 5091, E-Field, shaped, FCC probe in conjunction with the NBM550 survey meter. The EA 5091 probe is "shaped" such that in a mixed signal environment (i.e.: more than one frequency band is used in a particular location), it accurately measures the total percent of MPE.

From FCC OET Bulletin No. 65 - Edition 97-01 – "A useful characteristic of broadband probes used in multiple-frequency RF environments is a frequency-dependent response that corresponds to the variation in MPE limits with frequency. Broadband probes having such a "shaped" response permit direct assessment of compliance at sites where RF fields result from antennas transmitting over a wide range of frequencies. Such probes can express the composite RF field as a percentage of the applicable MPEs".

Probe Description - As suggested in FCC OET Bulletin No. 65 - Edition 97-01, the response of the measurement instrument should be essentially isotropic, (i.e., independent of orientation or rotation angle of the probe). For this reason, the Narda EA- 5091 probe was used for these measurements.

Sampling Description – Two types of sampling techniques were used for the AMI mesh network device exposure measurements. **"Spatial Averaging"** was used for exposure measurements taken at repeater, extender-bridge and collector locations. Spatial averaging is the technique used to measure ambient field exposure (E or H), or power density (S) averaged over a number of spatial locations. The measurements are performed by scanning (with a suitable measurement probe) a planar area equivalent to the area occupied by a standing adult human (projected area). In most instances, a simple vertical, scan of the fields along a 2 m high line, through the center of the projected area, is sufficient for determining compliance with the maximum permissible exposures (MPE) values. The NBM 550 survey meter collects time averaged measurements as the user slowly moves the probe vertically over a range of 20 cm (≈ 8 inches) to 200 cm (≈ 6 feet) above ground level. The results recorded at each measurement location include average values over the aforementioned spatial distance.

Instrumentation Information - A summary and specifications for the equipment used is provided in the table below.

Manufacturer	Narda Microwave			
Probe	EA 5091, Serial# 01088			
Calibration Date	December 2012			
Calibration Interval	24 Months			
Meter	NBM550, Serial# B-1149			
Calibration Date	December 2012			
Calibration Interval	24 Months			
Probe Specifications	**Frequency Range**	**Field Measured**	**Standard**	**Measurement Range**
	300 KHz-50 GHz	Electric Field	U.S. FCC 1997 Occupational/Controlled	0.5 – 600 % of Standard

Table 2: Instrumentation Information[2],[3]

For practical purposes and in consideration of the extended duration of each Smart Meter survey, exposure measurements for the meter locations involved a technique called **"Data Logging"**. Data logging is commonly used in scientific experiments and in monitoring systems where there is the need to collect information faster than a human can possibly

[2] Certificates of Calibration for the Narda Meter and EA5091 Probe used in these tests are provided as Attachments C & D of this Report.

[3] Instrument Measurement Uncertainty - The total measurement uncertainty of the NARDA measurement probe and meter is no greater than ±3 dB (0.5% to 6%), ±1dB (6% to 100%), ±2dB (100% to 600%). The factors which contribute to this include the probe's frequency response deviation, calibration uncertainty, ellipse ratio, and isotropic response.[3] Every effort is taken to reduce the overall uncertainty during measurement collection including pointing the probe directly at the likely highest source of emissions.

C2 Systems

collect the information and in cases where accuracy is essential. In measuring the Smart Meters the Narda was set to record the Maximum E-Field exposure percentage, in one second intervals, over a specified period. For the data logging tests the EA-5091 Probe was positioned a fixed distance, directly in front of the meter. A test distance of 1 meter (≈ 36 inches) was used for meter bank scenarios, (locations having multiple meters on a single building), and a test distance of 20 cm was used at single meter locations (on a single residence).

4. Smart Meter Location Selection

The Smart Meter locations surveyed were selected to meet two differing criteria. The first criteria was that the meter selected would have a high probability of having at least 2,000 descendants, and therefore a higher than average duty cycle. The second criteria was that the meter selected would be located in an uncongested RF environment, where the presence of nearby RF sources would be less likely, minimizing overall sampling contribution from sources unrelated to the CMP mesh network. In order to meet the first criterion, two meter locations were selected in high density areas of Portland. The first meter bank is located in the Oakdale section of the city and the second meter bank is off of Brighton Avenue, just north of Dougherty Field. Figure 1 below shows the general area in which sites M-1 and M-2 are located.

Figure 1: Meter Survey Locations M-1 and M-2 (Portland Area)

To satisfy the second criterion, a remote and rural residential area of Coastal Maine was selected, where the subject Smart Meter was more likely to have greater isolation from other nearby RF sources. (Reference Figure 2 below.)

Figure 2: Meter Survey (M-3) Locale (Coastal Maine)

5. AMI Meter Information - Test Set Up & Measurement Results

Described below is the test methodology and survey set-up for each AMI meter location tested (herein referred to as Location M-1 through M-3). Where multiple meters were collocated at a residence, the meter located at the highest above ground level (AGL), relative to the other meters, was selected to be measured.[4] In each case, except where noted, the Narda Broadband Meter and Probe were stationed 36" from the selected meter and adjusted to meet the height of that meter. All meter locations were surveyed between the hours of 11:50PM and 1:10AM, to capture the peak duty cycle period of the Smart Meter and mesh network.

5.1. Location M-1: Meter Information & Measurement Results

Location M-1 was a three meter bank residence in a densely populated area of Portland. Measurements for Location M-1 were performed on January 7-8, 2013, between the hours of 11:50 PM and 1:00 AM. The Narda™ Meter and Probe were positioned 36 inches from the middle meter and, at the same height as the center of the meter (Reference Figure 3 below). Specific information for each of the three meters at this location is presented in Table 3 below, along with a plot of the data logging results for this location showing the measured power density over a period of one hour and ten minutes.

[4] Where this survey was performed without the assistance of CMP, C Squared Systems is not privy to information concerning which meter in any bank of meters is considered the "parent" meter and which meters are "descendants".

C2 Systems

Figure 3: Location M-1 Meter Bank & NARDA Test Location

Meter Number	Manufacturer	Model Number	Serial Number	FCC ID	IC	CMP ID
1	Trilliant	RES-3000-FocusAX	NBZB0013448	TMB-G30Focus	6028A-G30Focus	108 086 888
2	Trilliant	RES-3000-FocusAX	NBZB0003280	TMB-G30Focus	6028A-G30Focus	108 086 886
3	Trilliant	RES-3000-FocusAX	NBZB0013413	TMB-G30Focus	6028A-G30Focus	108 086 887

Table 3: Meter Data – Location M-1

Standard procedures for measuring RF exposure and %MPE compliance typically involve spatially averaged measurements during active transmission periods of the RF source(s) under study. In the case of the Smart Meters, the extremely short duration of the pulses and the pulse periods (4.35ms over a 43.5ms time period) make it impractical to perform spatially averaged measurements over a one-hour period. Spatial averaging involves moving the probe in a slow sweeping vertical motion, across a height of 20cm to 200cm AGL (8in. to 6 ft.) at a fixed distance away from the source, for a period of 10 -

C2 Systems

15 seconds. Because of duration required in these tests, the Narda Meter was set to data logging mode, capturing and recording Maximum E-Field %MPE records[5] at one second intervals for a period of one hour and 10 minutes.

Figure 4 below is a graph of the % MPE data logged and measured for Location M-1. The exposure measuring device was set to record in one second intervals for a period of one hour and ten minutes. Where the Narda NBM 550 measuring device reports %MPE referenced at Occupational/Controlled Exposure levels, each % Max E-Field STD data record has been manually increased by a multiple of five (5) to adjust the reference to the General Population/Uncontrolled Exposure levels. As reflected in Figure 4, the highest measured %MPE recorded at this location was 13.4% of the FCC limit for General Population/Uncontrolled Exposure. Attachment G shows the 35-second window containing the peak measurement shown in Figure 4 below.

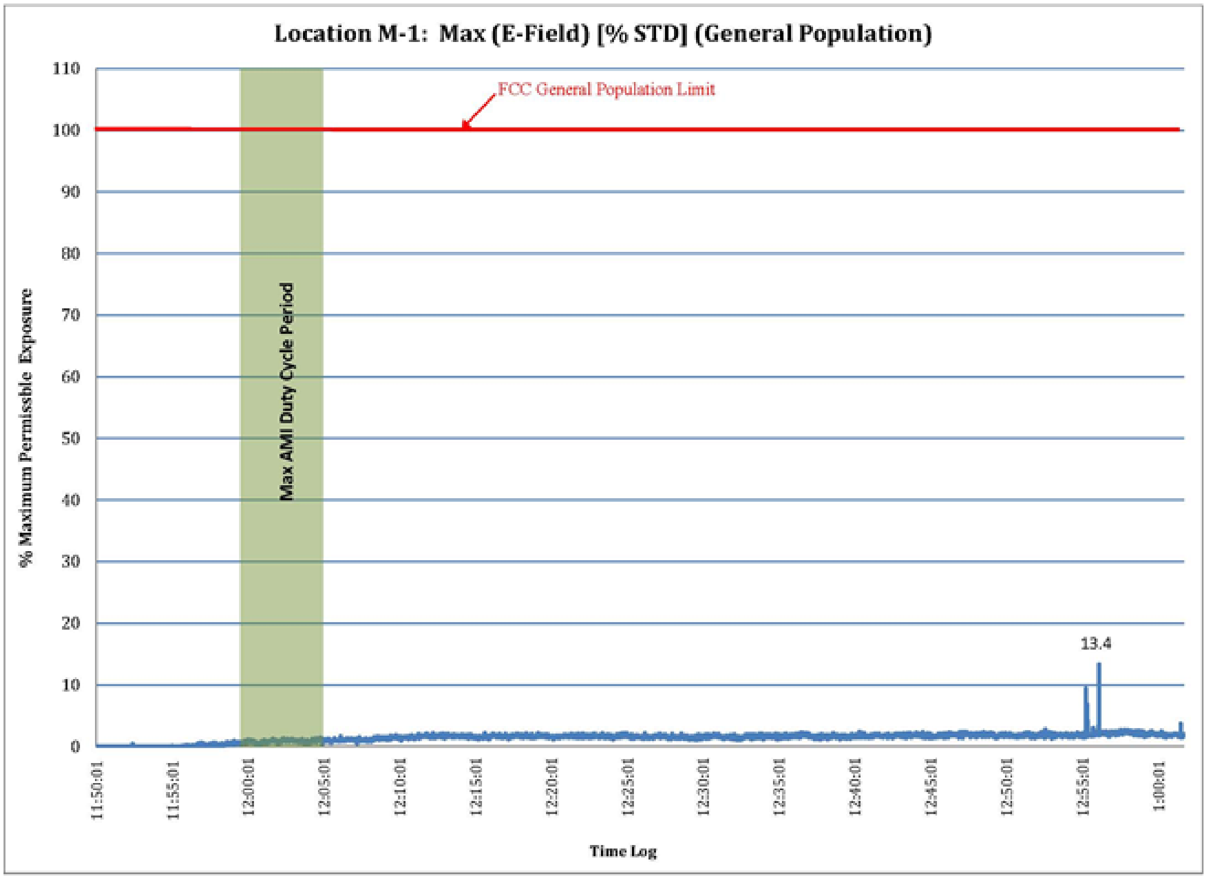

Figure 4: Location M-1 Data Logging Measurement Results

It should be noted that this reading was outside of the time period during which the Smart Meters operate at their maximum duty cycle (green-shaded area in Figure 4) and, that the source of the measurements taken during the test period include any and all potential RF sources in the area within the frequency range of the Narda broadband meter and probe (300 MHz to 50 GHz). Possible sources may include but are not limited to: Wifi, bluetooth, CATV, home security and automobile alarm systems. Therefore, it cannot be assumed that the Smart Meter monitored during this survey was the source of the peak readings reflected in the above graph for this location, or any levels measured during the field tests. [6] The only relative

[5] The data records captured by the Narda NBM 550 are %MPE values based on the FCC limits for Occupational/Controlled Exposure.

[6] While the majority of network broadcast activity occurs between 12:00 and 1:30 AM, information from CMP is that the most likely peak duty cycle period within that timeframe typically occurs between midnight and 12:05 AM. This particular value occurred outside the five minute window of expected maximum activity.

conclusion is that the Smart Meter may be contributing to the overall ambient power density measured. It should also be noted that 802.11b and 82.11g WiFi utilizes the same Industrial Scientific and Medical (ISM) frequency band (2.4 GHz) as the Smart Meter AMI Mesh Network. Figure 4 also shows that the highest %MPE occurred over a maximum period of one second.

5.2. Location M-2: Meter Information & Measurement Results

Location M-2 was a nine-meter bank configuration on an apartment building in a densely populated area of Portland, located approximately one-half mile away from Location M-1. Measurements for Location M-2 were performed on January 8-9, 2013, between the hours of 11:50 PM and 1:00 AM. The Narda™ Meter and Probe were positioned three feet from the Smart Meter designated as Meter 1 in Table 4 below. This particular meter was selected since it was the highest above ground relative to the other meters at this property making it the meter most likely to have the best line-of-sight path to the closest repeater, extender-bridge or collector. (Reference Figure 5 below for the test set up). Specific information for each of the nine Smart Meters at this location is presented below along with a plot of the data logging results for this location showing the measured power density over a period of one hour and ten minutes (Reference Figure 6 below).

Meter Number	Manufacturer	Model Number	Serial Number	FCC ID	IC	CMP ID
1	Trilliant	RES-3000-FocusAX	NBZB0001229	TMB-G30Focus	6028A-G30Focus	108 089 123
2	Trilliant	RES-3000-FocusAX	NBZB0012071	TMB-G30Focus	6028A-G30Focus	108 089 125
3	Trilliant	RES-3000-FocusAX	NBZB0001243	TMB-G30Focus	6028A-G30Focus	108 089 124
4	GE	RES-3000-1210+C	N/A	TMB-G301210	6028A-G301210	53 015 004
5	Trilliant	RES-3000-FocusAX	NBZB0001761	TMB-G30Focus	6028A-G30Focus	108 089 142
6	Trilliant	RES-3000-FocusAX	NBZB0012070	TMB-G30Focus	6028A-G30Focus	108 089 144
7	Trilliant	RES-3000-FocusAX	NBZB0001244	TMB-G30Focus	6028A-G30Focus	108 089 145
8	Trilliant	RES-3000-FocusAX	NBZB0001227	TMB-G30Focus	6028A-G30Focus	108 089 143
9	Trilliant	RES-3000-FocusAX	NBZB0013737	TMB-G30Focus	6028A-G30Focus	108 086 582

Table 4: Meter Data - Location M-2

C2 Systems

Figure 5: Location M-2 Meter Bank & NARDA Test Location

All % MPE values in the graph below are in reference to the FCC exposure limits for Uncontrolled/General Population. The highest measured %MPE was recorded at 5.39% of the FCC limit. It is important to note that the most reliable operating range of the Narda™ 550 NBM Meter and EA-5091 E-Field Shaped Probe is within the range of 6 to 100% Maximum Permissible Exposure (MPE). Levels below and above this range have varying degrees of linearity dependent upon the exact range of the field measurements. In the case of Location M-2, where the highest recorded reading is less than 6%, the linearity is +/- 3dB.[7]

[7] Reference Narda Safety Test Solutions NBM550 Probe specifications, p.64 http://www.narda-sts.us/pdf_files/DataSheets/NBM-Probes_DataSheet.pdf

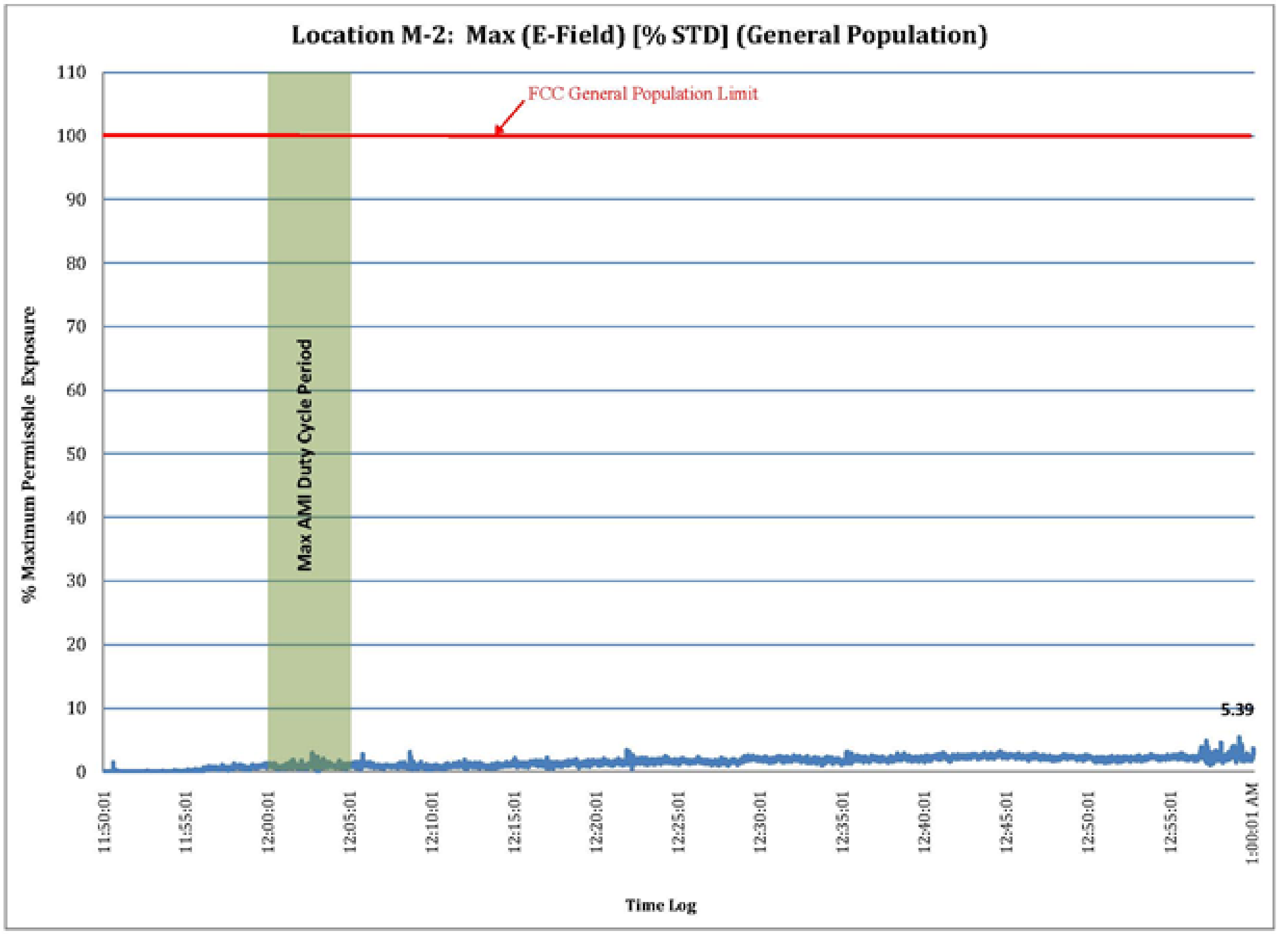

Figure 6: Location M-2 Data Logging Measurement Results

5.3. Location M-3: Meter Information & Measurement Results

To supplement Smart Meter measurements taken at meter bank locations in densely populated areas of Portland, it was decided that additional testing be performed at a single family residence/single meter location and, that these tests would include both exterior and interior measurements. The objective of these supplemental tests was first: to collect worst-case scenario exposure data in an RF environment less likely to have multiple contributing RF sources nearby, (unlike the environment in the urban test locations) and second, to measure RF exposure levels within a residence, at close proximity to the Smart Meter.

C2 Systems

Location M-3 is single family residence having a single Smart Meter. The residence is approximately thirty miles away from Locations M-1 and M-2, in a rural area of Coastal Maine. The property owners agreed to allow us to perform interior and exterior measurements, between the hours of 11:50 PM and 1:05 AM, on two different nights.[8]

Exterior measurements for Location M-3 were performed on January 21st and 22nd, between the hours of 11:50 PM and 1:05 AM. For this location, The Narda™ Meter and Probe were positioned at a distance of 20 cm away from the subject Smart Meter, as shown in the Figure 7 below. The reduction in measuring distance from 36" (≈1 meter) to 20 cm was to gather worst-case scenario information of a single Smart Meter in this RF environment. Specific information for the meter at this location is shown below in Table 5.

Manufacturer	Model Number	Serial Number	FCC ID	IC	CMP ID
GE	RES-3000-1210+C	NDEB0399685	TMB-G301210	6028A-G301210	52 971 246

Table 5: Meter Data - Location M-3

Figure 7: Location M-3: Exterior Measurement Test Setup

[8] In order to perform the tests using the same Narda equipment and test during the same peak duty cycle period of the AMI network (12:00 – 12:05 AM), two nights of testing were required.

C2 Systems

Measurements were performed on the 21st and 22nd of January 2013, between the hours of 12:55 AM and 1:05 AM. All % MPE values are in reference to the FCC Uncontrolled/General Population exposure limit. As shown in Figure 8 below, the highest %MPE measured within 20 cm of the Smart Meter was 5.59% of the FCC Uncontrolled/General Population limit.

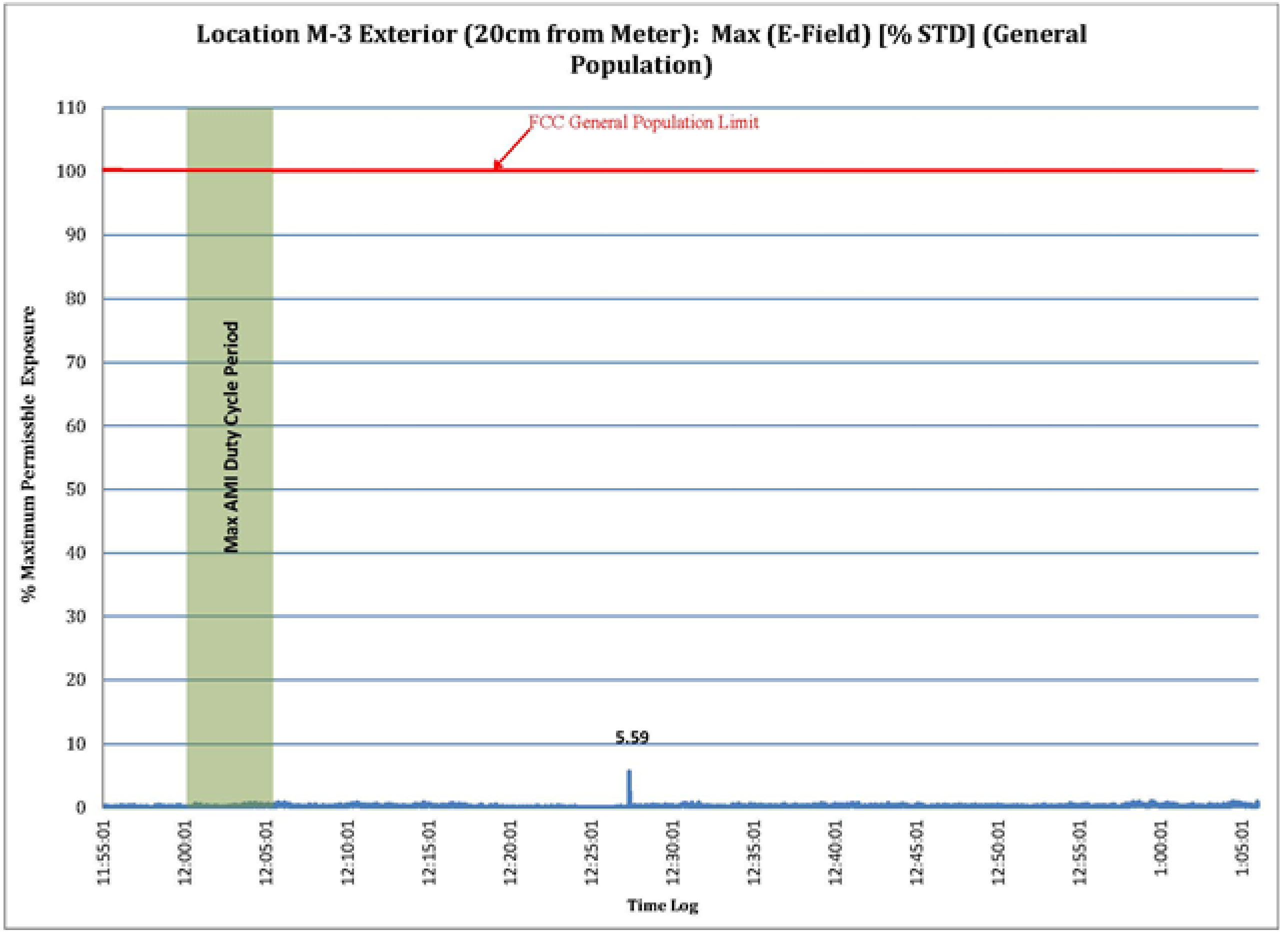

Figure 8: Location M-3 Data Logging Measurement Results (Exterior Readings)

This residence was equipped with multiple wireless devices including but not limited to; a home security system, WiFi, CATV, garage door openers, remote window shade devices, cordless and wireless mobile handsets. For this reason, one should not make the assumption that the maximum %MPE level recoded at 12:27:22 AM (shown in Figure 8) is attributable only to the Smart Meter.

Sample measurements of the ambient RF environment in and around the M-3 residence were taken using a WiSpy 2 Spectrum Analyzer show the presence of channel frequencies outside of the Smart Meter's frequency band. The WiSpy 2 analyzer measures both the magnitude and frequency of any the input signals detected.

As shown in Figure 9 below, the WiSpy 2 device captured channels within the frequency band of the Smart Meters (2.402 – 2.472 GHz) but it also recorded channels outside of the AMI meter's operating band, starting at 2.484 GHz. While these channels are not associated with the AMI Meter network their presence may still contribute to the %MPE levels recorded by the broadband probe of the Narda Meter

Figure 9: WiSpy 2 Spectrum Analyzer Results

5.4. Location M-3: Interior Meter Testing & Measurement Results

In addition to the exterior measurements performed at Location M-3, measurements were performed inside the residence on a different night but during the same maximum duty cycle period (12:00 AM – 12:05 AM). The Narda Meter and Probe were positioned inside the building, 20 cm from the interior wall at the same height and location of the exterior meter. Figure 10 below is a plot of the readings recorded within the residence.

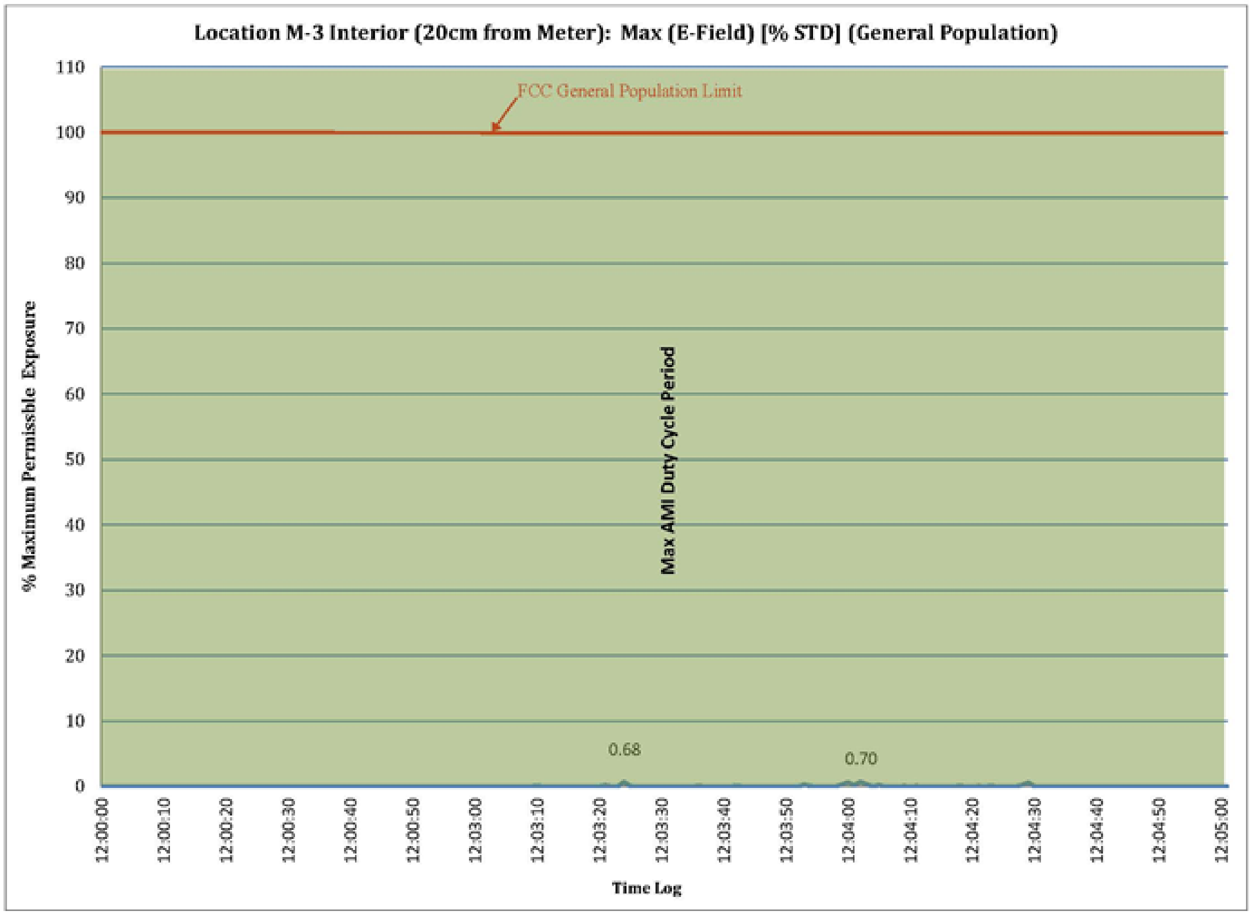

Figure 10: Location M-3 Data Logging Measurement Results (Interior Readings)

Note that the maximum %MPE readings were well below the recommended range of the EA 5091 Probe for optimum linearity (6% - 100%) and well below the less-than-optimal range (0.5% - 6%). Even by doubling the power density to account for the worse-case linearity of the probe at these recorded levels (+/- 3dB when < 6% of the standard), the maximum %MPE inside the building would be 1.4% of the FCC limit for the General Population (0.70 x 2 = 1.4%).[9]

6. Repeater/Extender Bridge and Collector Location Selection, Measurements, and Results

In addition to RF exposure measurements for the Smart Meters, C Squared Systems performed measurements at two repeater locations and one extender bridge/collector location. The repeaters and collectors measured in this testing were selected from a ranking of AMI Mesh Network devices based on the number of meters the devices potentially supported. The two repeaters chosen for the test had over 5,000 meters within a .5 mile of each repeater's location. The extender bridge/collector selected was listed as supporting over 2,000 Smart Meters.

[9] Every +/- 3 dB of probe linearity adjustment equates to doubling or halving of the %MPE. For worse-case scenarios the %MPE is increased by a factor of 2.

C2 Systems

The two repeaters selected were in high population areas of Portland and the extender bridge/collector was located in a hybrid commercial/residential area of Westbrook. Figure 11 provides a mapping of these locations.

Figure 11: Repeater and Extender Bridge/Collector Survey Locations

Where CMP provided the initial ranking list but was not consulted in the final selection process, there is no method of confirming the actual number of meters communicating with the repeaters and collectors selected for these tests, hence there is no implied statistical reference concerning the actual number of meters communicating with these devices. These tests were performed in response to concerns raised by the public that exposure measurements of these devices had not previously been conducted.

As discussed earlier in this Report, spatial averaging is the ambient field exposure (E or H), or power density (S) averaged over a number of spatial locations. [10] The averaging occurs across a vertical scan of the E-fields along a 2 meter high line, through the center of the projected area. It is the accepted method for exposure measurements of the ambient environment and appropriately used to collect power density and %MPE levels for the repeaters and collectors.

In the case of the Smart Meters measurements, data logging was the preferred method because of the short duration of the measurement process and the need to keep the measurement devices in a fixed position, relative to the meters and their internal antenna. The objective here was to measure the maximum %MPE at a fixed point from the meters, for a set period, in lieu of averaging spatial locations across a planar area.

The power density and %MPE levels for the repeaters and collectors were more appropriately measured using spatial averaging, the same methodology used industry-wide in measuring RF fields for both the general population and occupational workers exposed to single or multiple RF sources in the environment. Spatial averaging accounts for the distance from any source over the height of the human body, typically measured between 2' and 6' above ground level to account for the average height of any individual. Exposure measurements were made in the vicinity of each repeater and extender bridge/collector shown in Figure 11. Each spatial average measurement was taken for a period of no less than 15 seconds.

For each repeater, extender bridge/collector selected, measurement sample locations were derived based on the AGL centerline of the transmitting antenna on the transmission pole and, the vertical pattern of the transmitting antenna. The purpose of the latter was to ensure that the test measurement points were within the main beam of the device's transmitting antenna and not located within a null of the vertical antenna pattern, thus ensuring a worse-case scenario.

Measurement results and aerial views of the all locations surveyed are shown below. Photographs of each sample point surveyed and the subject AMI device may be found in Attachment E of this report.

[10] As defined in IEEE Std C95.7™-2005:§3.1.46: Different spatial averaging schemes are defined in various standards and guidelines. For frequencies up to 3 GHz, the average of the field strength squared or equivalent power density over an area equivalent to the vertical cross section of the adult human body, as applied to the measurement of electric or magnetic fields in the assessment of whole-body exposure.

C2 Systems

6.1. Measured Results – EB-119 Westbrook

Figure 12 below is a mapping of the Westbrook extender bridge/collector and the measurement points surveyed on January 8th between 2:00 and 3:00 PM.

Figure 12: Aerial View of Westbrook Collector and Measurement Locations

Results and a description of each survey location measured for the Westbrook extender bridge/collector are detailed in the table below. It is important to note that there are a number of nearby RF sources in the area that could contribute to the recorded %MPE levels measured in the area of the collector, including the Public Safety antennas on the roof of a neighboring building located within 275' of the collector.

Measurement Point	Latitude	Longitude	Distance to Collector (Ft.)	Ave %MPE Controlled/ Occupational	Ave %MPE Uncontrolled/General
1	43°40'55.64"N	70°20'54.91"W	99'	0.00%	0.02%
2	43°40'54.67"N	70°20'53.86"W	114'	0.00%	0.01%
3	43°40'54.22"N	70°20'54.49"W	84'	0.02%	0.10%
4	43°40'54.79"N	70°20'55.49"W	8'	0.02%	0.10%
5	43°40'54.45"N	70°20'56.28"W	70'	0.01%	0.06%
6	43°40'55.11"N	70°20'56.49"W	88'	0.02%	0.08%
7	43°40'53.61"N	70°20'56.35"W	134'	0.11%	0.53%
8	43°40'55.87"N	70°20'56.28"W	132'	0.03%	0.17%

Table 6: Collector Survey Data – Westbrook, ME

C2 Systems

6.2. Measured Results: Repeater #080 (Houlton St.)

Figure 13 below is a mapping of the Houlton St repeater and the surrounding measurement points surveyed on January 9th between 11:00 AM and 12:05 PM.

Figure 13: Aerial View of Houlton St Repeater and Measurement Locations

Results and a description of each survey location measured for the Houlton St repeater are detailed in the table below.

Measurement Point	Latitude	Longitude	Distance to Collector (Ft.)	Ave %MPE Controlled/ Occupational	Ave %MPE Uncontrolled/General
1	43°39'06.36"N	70°16'09.38"W	113'	0.00%	0.02%
2	43°39'04.97"N	70°16'11.06"W	116'	0.01%	0.03%
3	43°39'04.98"N	70°16'08.42"W	86'	0.00%	0.02%

Table 7: Repeater PORT01-080 Survey Data – Houlton St

6.3. Measured Results: Repeater #131 (Deering St.)

Figure 14 below is a mapping of the Deering St repeater and the surrounding measurement points surveyed on January 9th between 12:30PAM and 1:00 PM.

Figure 14: Aerial View of Deering St Repeater and Measurement Locations

Results and a description of each survey location measured for the Deering St repeater are detailed in the table below.

Measurement Point	Latitude	Longitude	Distance to Collector (Ft.)	Ave %MPE Controlled/ Occupational	Ave %MPE Uncontrolled/General
1	43°39'16.33"N	70°15'57.50"W	106'	0.00%	0.00%
2	43°39'16.54"N	70°15'55.53"W	78'	0.03%	0.16%
3	43°39'16.00"N	70°15'54.71"W	108'	0.06%	0.29%
4	43°39'15.63"N	70°15'57.51"W	103'	0.06%	0.28%
5	43°39'15.23"N	70°15'56.55"W	76'	0.05%	0.26%

Table 8: Repeater NCPO1-131 Survey Data – Deering St

C2 Systems

6.4. Repeater, Extender Bridge/Collector Measurement Findings

All %MPE levels measured for the repeaters and collectors were found to be well below the lower range of the Narda Meter and Probe (.5% - 6%). Even by doubling the power density to account for the worse-case linearity of the meter at these recorded levels (+/- 3dB when < 6% of the standard), the maximum %MPE measured near any of the repeaters or collector was 1.06% of the FCC limit for the General Population (0.53 x 2 = 1.06%). The latter was recorded at Measurement Point 7 in Westbrook.

7. Summary of Findings

The RF exposure measurement survey completed by this office in January of 2013 verifies that emissions from the Smart Meters and associated AMI infrastructure devices surveyed are well below the maximum power density levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01 for the General Population/Uncontrolled Exposure. Even when using conservative methods, the cumulative power densities around the devices measured are well below the limits established for the general public. The highest measured ambient Maximum Permissible Exposure near a Smart Meter was **13.4%** of the FCC limit. The same point with averaging applied (as is recommended when measuring exposure levels), would be **4.6%** of the FCC limit. (Reference Max vs. Avg. Graph presented as Figure 16)

This measurement was taken at Location M-1 and occurred outside of the maximum duty cycle of the Smart Meter. There were a number of nearby sources in the area that may have contributed to this higher than average reading, (previously cited within this Report).

RF exposure measurements taken within the main lobe of the transmitting antennas of the repeaters and extender bridge/collectors were found to be below the limits of the Narda Probe and well below the FCC limits for the General Population. The maximum level measured was 0.53% of the General Population/Uncontrolled limit.

8. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The measurement procedures follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1, ANSI/IEEE Std. C95.7 and FCC OET Bulletin 65 Edition 97-01.

Daniel K. Goulet

January 25, 2013

Daniel L. Goulet — Date

C Squared Systems, LLC

C2 Systems

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

ANSI C95.1-1982, American National Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. IEEE-SA Standards Board

IEEE Std C95.3-1991 (Reaff 1997), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. IEEE-SA Standards Board

IEEE Std C95.7-2005, IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz. IEEE-SA Standards Board

C2 Systems

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[11]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[12]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz   * Plane-wave equivalent power density

Table 9: FCC Limits for Maximum Permissible Exposure

[11] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure

[12] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

C2 Systems

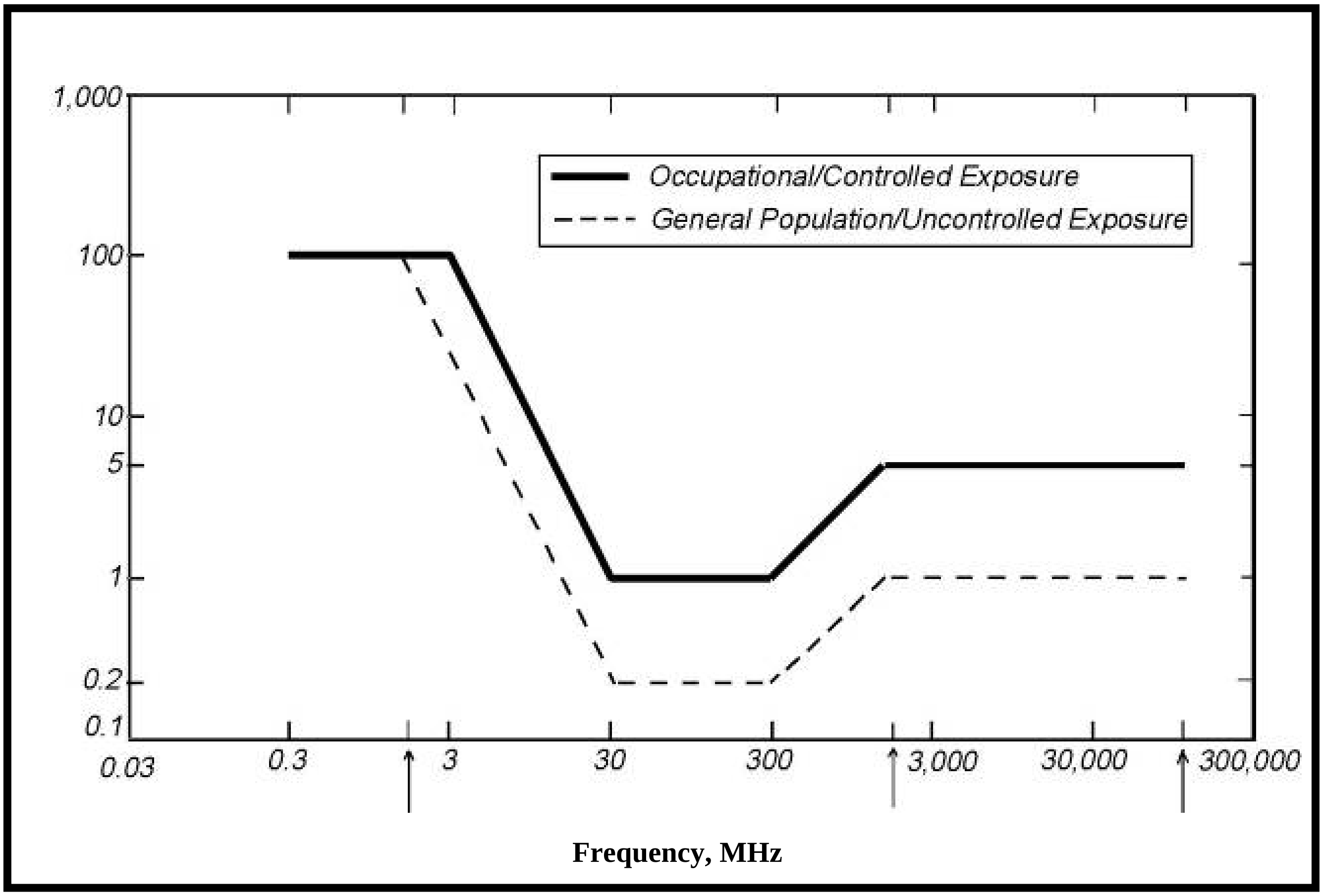

Figure 15: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

C2 Systems

Attachment C: Certificate of Calibration - Narda NBM-550 Meter

Page 1 of 1

L3 communications
Narda Microwave-East

Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced instrument has been calibrated by qualified personnel to Narda's approved test procedures.

Furthermore, the instrument meets, or exceeds, all published specifications and the calibration has been performed with test instrumentation that, where applicable, is traceable to the National Institute of Standards and Technology.

Narda's calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the bureau's calibration facilities.

Customer: C SQUARED SYSTEMS LLC
AUBURN, NH 03032

Certificate #: 126539 1

Model #: 2401/01

Serial #: B-1149

Description: NBM-550 METER, BASIC UNIT

PO #: 10004511

Date Calibrated: 12/06/2012

R.O. #: 126539

Hugh Saunders
Hugh Saunders
Test

Ken Peck
Quality Assurance

L-3 COMMUNICATIONS, NARDA MICROWAVE-EAST, 435 MORELAND ROAD, HAUPPAUGE, NEW YORK 11788, TEL: 631-231-1700, FAX: 631-231-1711

C2 Systems

Attachment D: Certificate of Calibration – FCC EA 5091 Shaped Probe

Page 1 of 1

L3 communications
Narda Microwave-East

Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced instrument has been calibrated by qualified personnel to Narda's approved test procedures.

Furthermore, the instrument meets, or exceeds, all published specifications and the calibration has been performed with test instrumentation that, where applicable, is traceable to the National Institute of Standards and Technology.

Narda's calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the bureau's calibration facilities.

Customer: C SQUARED SYSTEMS LLC
AUBURN, NH 03032

Certificate #: 126539 2

Model #: 2402/07

Serial #: 01088

Description: FCC SHAPED PROBE 300 KHZ-50 G

PO #: 10004511

Date Calibrated: 12/13/2012

R.O. #: 126539

Hugh Saunders
Hugh Saunders
Test

Ken Peck
Quality Assurance

L-3 COMMUNICATIONS, NARDA MICROWAVE-EAST, 435 MORELAND ROAD, HAUPPAUGE, NEW YORK 11788, TEL: 631-231-1700, FAX: 631-231-1711

C2 Systems

Attachment E: Survey Photographs

Photo 1: Westbrook Extender Bridge/Collector EB#119

Photo 2: Westbrook Extender Bridge/Collector EB#119 Nearby RF Sources

Photo 3: Deering St Repeater RR#131and Nearby RF Sources

Photo 4: Deering St Smart Meter Bank Near Repeater RR#131

C2 Systems

Photo 5: Houlton St Repeater RR#080

C2 Systems

Attachment F: Narda Data Logging Sample Results Location M-1

Time	Max (E-Field)% [Occupational Standard]	Avg (E-Field)% [Occupational Standard]	Max (E-Field)% [General Population]	Avg. (E-Field)% [General Population]
12:55:50	0.3951	0.3348	1.9755	1.674
12:55:51	0.3549	0.3388	1.7745	1.694
12:55:52	0.3817	0.3375	1.9085	1.6875
12:55:53	0.3817	0.3603	1.9085	1.8015
12:55:54	0.4487	0.4045	2.2435	2.0225
12:55:55	0.4018	0.3496	2.009	1.748
12:55:56	0.442	0.3938	2.21	1.969
12:55:57	0.4018	0.3563	2.009	1.7815
12:55:58	0.4018	0.3549	2.009	1.7745
12:55:59	0.4688	0.4018	2.344	2.009
12:56:00	0.4621	0.4112	2.3105	2.056
12:56:01	0.4554	0.3844	2.277	1.922
12:56:02	0.375	0.3134	1.875	1.567
12:56:03	0.375	0.304	1.875	1.52
12:56:04	0.3817	0.3576	1.9085	1.788
12:56:05	0.3817	0.3147	1.9085	1.5735
12:56:06	0.6831	0.4299	3.4155	2.1495
12:56:07	0.3616	0.2987	1.808	1.4935
12:56:08	2.679	0.8799	**13.395**	**4.3995**
12:56:09	0.3951	0.3545	1.9755	1.7725
12:56:10	0.3884	0.3763	1.942	1.8815
12:56:11	0.3817	0.3522	1.9085	1.761
12:56:12	0.4286	0.3616	2.143	1.808
12:56:13	0.3683	0.3455	1.8415	1.7275
12:56:14	0.3951	0.363	1.9755	1.815
12:56:15	0.4554	0.4072	2.277	2.036
12:56:16	0.4286	0.3777	2.143	1.8885
12:56:17	0.4219	0.3924	2.1095	1.962
12:56:18	0.3951	0.3616	1.9755	1.808
12:56:19	0.4889	0.4607	2.4445	2.3035
12:56:20	0.4554	0.4139	2.277	2.0695
12:56:21	0.4085	0.3536	2.0425	1.768
12:56:22	0.4955	0.4018	2.4775	2.009
12:56:23	0.442	0.3951	2.21	1.9755
12:56:24	0.4688	0.4005	2.344	2.0025
12:56:25	0.4152	0.383	2.076	1.915

Table 10: Data Logging Location M-1 (Period: 12:55:50 – 12:56:25)[13]

[13] The %MPE values recorded in this Report were derived by taking the recorded "Max E-Field % Occupational Standard and multiplying it by a factor of 5 to yield the "Max E-Field % General Population Standard" shaded in blue.

C2 Systems

Attachment G: Data Log Segment - Location M-1 Max vs. Avg.

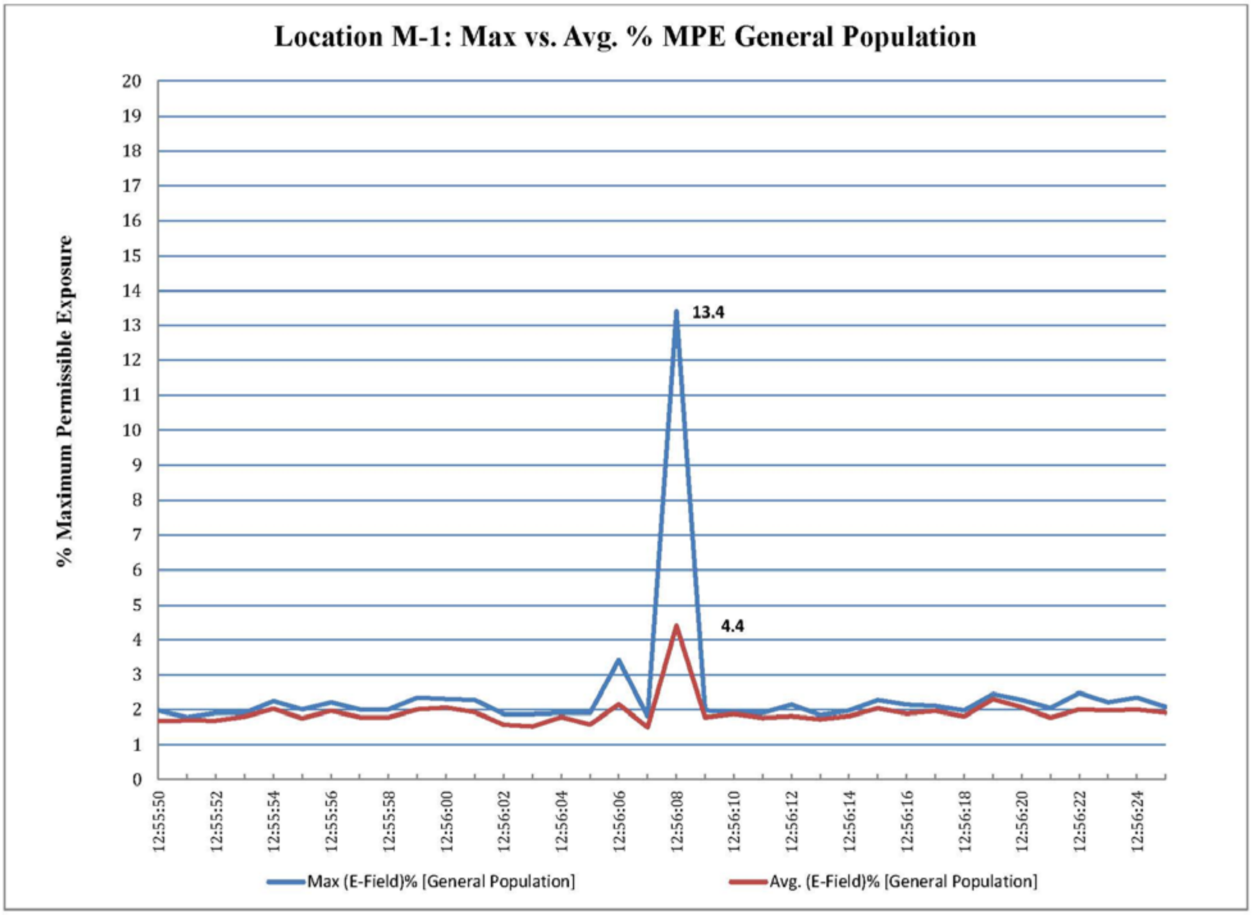

Figure 16: Maximum vs. Average %MPE [General Population Standard][14]

[14] Please note that the range for the maximum value used for the vertical axis of the graph shown in Figure 16 has been decreased from a maximum value of "110" to a maximum value of "20" to provide the resolution needed to view the Max vs. Avg. of the plotted data points.